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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
BLUM, DAVID S	
ART UNIT	**PAPER NUMBER**
2813	

DATE MAILED: 10/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/883,981	ANDREWS ET AL.	
	Examiner	Art Unit	
	David S Blum	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 August 2004* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *8,15,23-32,34-39 and 41-46* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *8,15,23-32,34-39,41-46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

This action is in response to the amendment filed 08/10/04.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 8, 15, 23-39, and 41-46 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 8, 15, 23, 41, 45, and 46 (and thus their dependent claims) contain the limitation "slightly-etched surface" in the planar surface. This term is used (in the specification, page 7) in describing the filler surface prior to covering with a photoresist, removing the photoresist and planarizing the filler surface. This is a description of an intermediate structure, not a final, planar structure. Thus, toward the final structure, this is unclear as to what is being claimed. Also, although the term "etched slightly" is used in the specification, there is not sufficient description to define the metes and bounds of "etched slightly".

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 8, 15, 23-25, 27, 29-32, 34-36, 38-39, 41-42, and 45-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng (US 5,728,621) in view of Liao (US 6,110,795).

Zheng teaches the device of claims 8, 15, 23-25, 27, 29-32, 34-36, 38-39 and 41-42 except for reciting that the trench fill is "seamless" and "substantially scratch free" and co-planar with the substrate. Zheng teaches the device structure of the claims in that a thin oxide layer (12) is grown, (the process mechanism is given no patentable weight in device claims, see product by process discussion below) on the substrate (including the non-trench region) as in claim 34, and wide and narrow shallow trenches (figure 6) are formed on a substrate, and the trenches are filled by a non-conformal high density plasma method (18) and the filler is removed from the pad leaving trench fill in the trench and a planar surface. One of the problems Zheng is curing is keyholes or weak seams (column 1 lines 19-20) suggesting a seamless fill. Figure 7 shows the trench fill and the substrate to be co-planar as in figure 6 of the instant application. The filler material is silicon oxide by a high-density plasma method (column 3 lines 45-47). It is the high-density plasma trench fill method that results in the seamless trench fill (per

instant application). It is obvious that as the process steps are like, the results will be the same. Zheng is also silent as to the surface being scratchless, but teaches the trench fill may be either optionally polished or selectively etched (suggested method) to the pad layer (column 3 lines 15-25). Zheng teaches further removal of the trench fill may be optional. Figure 3 shows the high-density plasma oxide fill to be non-conformal as in claims 24 and 38. Thus Zheng teaches an etched unpolished surface. Further, Liao teaches CMP creates micro-scratches and that etching is an improvement over CMP to avoid having a surface with micro-scratches.

Even though product-by-process claims are limited by and defined by the process, determination of Patentability is based upon the product itself. The patenability of a product does not depend on its method of production." MPEP 2113

Regarding the limitation "upper surface of said non-trench region comprising implanted dopants" (claims 8, 15, and 23), this is conventional in trench isolations as the trenches are used to separate/isolate devices such as transistors and transistors have implants/dopants in the substrate surface to form source/drains. Zheng (figure 10) shows this as part #34. Zheng refers to parts 34 as source and drain regions (column 3 line 45) but does not state that the region contains dopants. This is inherent to source and drains, that without a dopant species, they will not function. That the dopants are implanted (product by process limitation) is given no patentable weight as previously discussed. It is not patentable as to the process of placing the dopants (implant,

diffusion), but that they are present in the structure. Zheng teaches source/drains, thus the dopants are present.

Regarding the limitation "wherein the upper surface of said HDP oxide comprises a slightly-etched surface, such that a thickness of said single layer of HDP oxide comprises an as-deposited thickness" (claims 8, 15, and 23), as the HDP layer (fill) of Zheng is deposited, a thickness (any thickness) of the layer comprises an as-deposited thickness. Further, page 8 of the instant specification teaches that an etch is beneficial, but not necessary. Thus it is not critical to have an etched surface.
Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).
Further, Zheng teaches planarizing by either CMP or etching (column 3 lines 15-25). Thus the HDP oxide has an etched surface. Liao teaches an etched surface to the HDP oxide.

Regarding the limitation "wherein said as deposited thickness is substantially the same as an originally deposited thickness", as best understood by the examiner, this refers to the deposited thickness being equal to the original thickness of the layer without any polishing or etching that decreases it's thickness. This is accomplished by masking the

oxide fill prior to etching. Zheng also masks the oxide fill prior to etching and the fill of figure 10 is substantially the same as the as-deposited fill of figure 8. Zheng (column 3 lines 32-38) teaches that the step height between the active areas and the isolation areas is reduced with some over etch, but the examiner believes this still teaches that the remaining thickness is substantially the same as the deposited thickness. Further, the instant specification teaches that some etch to the layer will occur ("before the photoresist is applied to the wafer surface and patterned, the deposited filler material is etched slightly" page 7 lines 20-21, "an equal amount of films 50a and 50b are likewise removed by the etch process" page 8 lines 4-5, see figures 1 and 2, the resultant thickness of the fill is less than the original as-deposited fill). Thus in light of the specification (teaching the resultant thickness of the fill is less than the original as-deposited fill), Zheng is considered to be within "substantially" the same as an originally deposited thickness.

Liao also teaches using selective etching (not reactive ion etching) to avoid micro-scratches caused by polishing, but does not etch down to the substrate level. Thus, Zheng teaches a method which will result in a structure being substantially scratch free, and Liao teaches an improvement to Zheng (etching over CMP) which of the methods will yield the desired result. As defined by the specification, chatter marks are caused by CMP and by Liao teaching away from CMP to avoid micro-scratches, the lack of polishing will also eliminate chatter marks.

The limitation where the surface is planarized "without etch back" or "without reactive ion etching" or "without chemical mechanical polishing" is considered a process limitation on the product and is given no patentable weight. The surface need only be planarized to be of the same structure.

Even though product-by-process claims are limited by and defined by the process, determination of Patentability is based upon the product itself. The patenability of a product does not depend on its method of production." MPEP 2113

Regarding the limitation "wherein said unpolished upper surface of said HDP oxide has been etched to expose a pad oxide layer formed on said upper surface of said non-trench region, this is also a product by process limitation and given no patentable weight. The structure need only have the pad oxide exposed. Also, as figure 6 shows the pad oxide covered by the nitride layer above it and figure 7 shows the pad oxide removed, it is determined that this limitation is toward an intermediate structure. Zheng shows the pad oxide covered by the nitride layer (figure 6) and figure 7 shows the pad oxide removed, as in the instant application. Zheng teaches, the nitride layer is etched away (thus the pad oxide is exposed in an intermediate structure) and the pad oxide is removed (column 3 lines 26-28).

Regarding claim 36, Zheng teaches at least one wide trench and at least one narrow trench (figure 2).

Regarding claim 39, Zheng teaches the device structure of the claims in that a thin oxide layer (12) is grown (the process mechanism is given no patentable weight in device claims) on the substrate (including the non-trench region). This is considered to be a high-purity oxide, the term "high –purity" not being defined in the original claims or specification.

Regarding new claim 45, the limitation of "slightly etched surface" page 7 of the instant specification teaches this to be a description of an intermediate, non-planar surface, not the planar structure. Page 8 of the instant specification teaches that an etch is beneficial, but not necessary. Thus it is not critical (as recited above) to have an etched surface. Further, as recited above, Zheng teaches CMP or etching. Thus the HDP oxide has an etched surface. Also, Liao teaches an etched surface.

Regarding new claim 46, the limitation of "isotropically-etched surface", page 8 of the instant specification teaches that an etch is beneficial, but not necessary. Thus it is not critical (as recited above) to have an etched surface. . Further, as recited above, Zheng teaches CMP or etching. Thus the HDP oxide has an etched surface. Also, Liao teaches an etched surface. Also, although not stated, figures 5-6 of Zheng and 2C-2E of Liao suggest that the etch is an isotropic etch.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Zheng by choosing a removal method taught by that will result in a substantially

scratch free surface as taught by Liao with reasonable expectation of producing a trench fill with a planar surface with reduced surface flaws (Zheng, background, Liao).

5. Claims 26, 28, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng (US 5,728,621) in view of Liao (US 6,110,795) and in further view of Kunikiyo (US006620703B2).

Zheng and Liao teach the device of claims 26, 28, and 37 as recited above in regard to claims 8, 24, and 23 except for the high-density plasma oxide comprising fluorine-doped high-density plasma oxide.

Kunikiyo teaches filling the isolation trench with a doped oxide, particularly SiOF, fluorine doped silicon oxide (column 10 lines 54-55) as in claims 26 and 28. The dopant improves upon the mismatch in volumetric expansion between the fill and the silicon substrate during subsequent heating steps (column 10 lines 59-67) and reduces leak current (column 11 lines 1-5).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Zheng and Liao by using a (fluorine) doped fill as taught by Kunikiyo to improve upon the mismatch in volumetric expansion between the fill and the silicon substrate during subsequent heating steps (column 10 lines 59-67) and reduces leak current (column 11 lines 1-5).

6. Claims 43-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng (US 5,728,621) in view of Liao (US 6,110,795) and in further view of Brewer (US 6,332,600).

Zheng and Liao teach the device of claims 43-44 as recited above in regard to claim 8, except for the HDP oxide comprising a phosphorous doped oxide (claim 43) or a boron doped oxide (claim 44).

Zheng and Liao teach a HDP oxide, but are silent as to any doping. Brewer teaches filling trenches with HDP oxides, undoped oxide, phosphorous doped (PSG and BPSG) and boron doped (BPSG) (column 11 lines 53-65) thus giving the materials an art recognized equivalence for trench filling.

Further, pages 5 and 6 of the instant specification teaches no criticality between a doped or undoped trench fill.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Zheng and Liao by using a (phosphorous or boron) doped fill as taught by Brewer to have an art recognized equivalence.

Response to Arguments

7. Applicant's arguments filed 4/23/04 have been fully considered but they are not persuasive.

8. The applicant argues that because of harsh etching or polishing, the surfaces of conventional trench fills contain scratches and chatter marks. Zheng is silent as to the surface quality. Liao teaches a surface free of scratches, as does Brewer. Further, although the process for forming the trench fill may differ from the individual cited prior arts, it is the device, a planarized scratch free trench fill that is held to be un-novel. That the surface is "slightly etched" in the final (planar) structure is unclear. The instant specification describes this in an intermediate structure, not the planar structure. The surface of Zheng is polished (CMP) or etched, thus the surface may be etched. The description "slightly" is undefined. Liao teaches etching the surface as an improvement to avoid micro-scratches. Thus in view of Liao, one would have a surface that is etched.

The applicant argues that in the claimed substrate, the upper surface of the HDP oxide includes a slightly etched surface. Again, this limitation is in Zheng and taught by Liao. The description "slightly" is undefined.

The applicant argues that Zheng and Liao would not be combined as Liao teaches a method of correcting damage caused by CMP. The examiner believes this is a reason for combining. One skilled in the requisite art would (upon reading Liao) combine the two teachings to result in a planar surface without surface scratches, thus resulting in the device of the instant specification. Thus if Liao teaches the Zheng device is defective, Liao teaches a "fix" to the defect.

It is understood by the examiner that the instant specification teaches that CMP produces a surface that the applicant finds inferior due to scratches. The instant application teaches that the etch step is optional, thus the etched surface is not critical. There is criticality taught that the surface is not planarized by CMP, but having an etched surface (current limitations) reads on Zheng (CMP or etched). Further, Liao teaches a scratch free surface by etching in lieu of CMP. Thus, even with a limitation that eliminates the CMP surface of Zheng, in light of Liao, one would opt for an etched surface.

The applicant argues that the examiner cannot point to any motivation for combining the two references, thus no prima facie case of obviousness has been made. The applicant has provided such motivation. According to the applicant, Liao teaches the device of Zheng is defective, and Liao teaches a surface that cures the defect. This is motivation to combine.

The applicant argues regarding "wherein said upper surface comprises a slightly-etched surface...". This is a new limitation and arguments will not be fully addressed here. Please see the rejections above.

The applicant argues that Zheng is significantly etched and the instant application is slightly etched. Slightly is not defined in the specification. Further, the claims regard the device, not how the device is made. Any defects in the Zheng device surface are addressed by Liao.

The applicant argues that the Kunikiyo reference would not be combined with Zheng and Liao because Zheng and Liao are toward planarizing surfaces and Kunikiyo is toward improving isolation characteristics. It is just this argument that creates motivation to combine.

The applicant argues that Kunikiyo flattens the trench fill by CMP and does not teach a slightly etched surface. Kunikiyo was used to provide motivation for using a fluorine doped fill (non-critical) and not the planar surface. Zheng and Liao teach a planar surface and Liao teaches a scratch free surface.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (757)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile number all patent correspondence to be entered into an application is (703) 872-9306. The facsimile number for customer service is (703)-872-9317.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David S. Blum

October 18, 2004